

NPIC/TDS/D-992-67
29 August 1967

Declass Review by NGA.

MEMORANDUM FOR: Assistant for Technical Development, NPIC

THROUGH: Chief, Development Staff, TDS

SUBJECT: FY-1968 Project for Development of Split-Format
1440 Light Table #NP-V-28-02288

1. It has proven impossible to write the development objective for this project at this time for the following reasons:

- a. There have been a series of vacillations in PAG's requirements as regards to this table.
- b. There have been a number of changes recently made in the acquisition system for which this table is intended-- these relate primarily to changes in the width of the film which, of course, governs the format of the light table.
- c. This table is basically built around a current project-- the 9 X 40 split-format light table, that we are building with [] which has a modified focusing mount and film take up. We are waiting to see how acceptable this table is before we can determine what additional modifications should be made in this advanced unit.

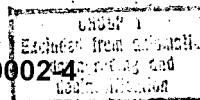
2. It is hoped that these particular areas of concern will have resolved themselves by the latter part of September and we will attempt to write the DO at that time. The development objective should be expected now on the 4th of October 1967 vs. the 4th of August 1967.

[]
Chief, Exploitation Systems Branch, DS

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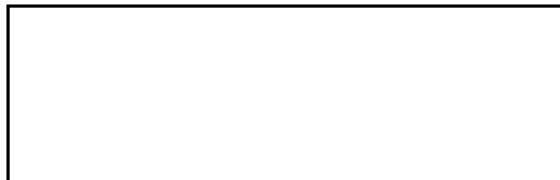
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OPERATION/MAINTENANCE MANUAL
MIM-6 (1540)

PROTOTYPE
MOD I



25X1

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INTRODUCTION

The MIM 6 (1540) Light Table is the result of extensive design engineering and testing. Ease of operation, low maintenance cost and long productive life were the main factors in the design of the MIM 6 (1540) Light Table. The MIM 6 (1540) Light Table is a portable self standing unit with manual or power elevating features.

The overhead carriage has a variable speed motor drive for fine feed control in the "X" and "Y" axis and manual override for rapid positioning. The Master Carriage will accommodate virtually all current optical systems. Four fixed and two movable bi-directional high torque motors provide for viewing of single strands of 70MM, 5", 6.6", or 9.5" wide film, or any combination of 70MM, 5", or 6.6" film for dual strand viewing at variable film speeds from 0 to 500 feet per minute.

The split viewing stages, mechanical film loop accumulator, and bi-directional film transporting motors make possible a variation of film threading configurations to meet operational acquisition requirements. Two 15" x 20" encapsulated oil cooled light grids illuminate the viewing stages with variable light intensity from 100 to 3000 ft. Lamberts. The controls are so located to provide easy access and simplify operation.

This manual will cover operation and operator maintenance of the MIM 6 (1540) Light Table.

SPECIFICATIONS

Length	58 inches
Width	35
Height	
Maximum	73 inches
Stage Elevation	
Maximum	48
Weight	570 lbs.
Illuminated Surface	Two 15" x 20" areas
Light Intensity	
Maximum	3000 ft. Lamberts
Minimum	100 ft. Lamberts
Power Requirements	115 Volts 50/60 Cycle AC
Environmental Requirements	NONE

NOTE

Although the Light Table will perform in an uncontrolled area, it is recommended, for protection of the film, that an area of operation be selected that incorporates control of temperature, humidity, dust, etc.

SECTION 1

GENERAL DESCRIPTION

1.1 This section describes the various components and systems, their capacities, specifications and performance.

1.2 VIEWING STAGE

1.2.1 The viewing stage is the illuminated areas where film or films are positioned for scanning or viewing.

1.2.2 The viewing stage consists of two 15" x 20" pieces of plate glass mounted over diffusing material of the same dimension. The plate glass and diffusion material are slightly separated to prevent newton rings, but are sealed to prevent dust and moisture from accumulating in the separation area. The viewing stage frame serves a twofold purpose: The viewing stage is split at center, and either side can be shifted left and right for film threading.

1.3 ILLUMINATION

1.3.1 Illumination is delivered to the viewing stage by two encapsulated, oil cooled, cold cathode argon mercury light grids at a minimum of 100 to a maximum of 3000 ft. Lamberts.

1.4 MASKING

1.4.1 Viewing stage masking assemblies located between the illumination source and the viewing stages are provided to reduce extraneous light when viewing film or films.

1.4.2 The rear mask consists of a 15" x 20" sheet of 300 gage polyester film, dyed black and attached to a spring loaded roller at one end with a manual parallel cable control bar at the other end. This provides for positioning of the mask from the rear to the front of the viewing stage.

1.4.3 The front mask consists of a manual parallel cable control bar 9/16" x 20 inches. This provides for masking between the dual film strands.

1.5 MICROSCOPE CARRIAGE

1.5.1 The microscope carriage is of an overhead design incorporating the following:

1.5.1.1 Pre-loaded recirculating ball bearings, on all carriage motions, to produce "0" backlash in "X", "Y", and "Z" motions.

1.5.1.2 Quick release devices for removal of the carriage bridge during shipment or for convenience without disturbing collimation adjustments.

1.5.1.3 Electrical clutch de-coupling for manual, rapid free movement along "X" and "Y" axis.

1.5.1.4 Electric motor drives at variable speed for fine adjustment along the "X" and "Y" axis through an eight position joy stick switch.

1.5.1.5 Course and fine focus adjustment in "Z" axis with rapid manual elevating of microscope carriage.

1.5.1.6 Gravity feed with over riding miniclutch in "Z" axis to prevent feeding of optical instrument into view stage with resultant damage to instrument or film.

1.5.1.7 Provisions for accommodating virtually all current optical systems.

1.6 FILM TRANSPORT SYSTEM

1.6.1 Four bi-directional torque motors, for film transport and tension control, are so arranged on the light table frame to accommodate any film threading configuration for 500 ft. spools maximum.

1.6.2 Two motorized reel brackets, two center idler reel brackets and two spindle reel brackets make possible the viewing of various size and combination of film sizes.

1.7 POWER CONTROLS

1.7.1 The main power control is located on the recessed panel behind the right viewing stage. See Fig. 1.

1.7.2 The left and right motor control stations are located on the front of the light table respective to their function. See Fig. 2.

1.7.3 The microscope carriage controls are located at the left rear of the microscope adapter ring. See Fig. 4.

1.7.4 Two manual override film scan knobs are located at the left and right front of the light table. See Fig. 2.

1.8 MANUAL CONTROLS

1.8.1 The manual elevating crank is located at the right rear of the light table. To operate push crank in and rotate left or right until desired elevation is attained. See Fig. 5.

1.8.2 Stage shifter handles are located on the front of the light table. See Fig. 2.

1.8.3 Film loop accumulator is located on the right front of the light table. See Fig. 2.

1.9 FILM LOOP ACCUMULATOR

1.9.1 The mechanical film loop accumulator consists of a combination of shafts, chains, chain magazines, chain guides, sprocket meter gears and worm gear mechanisms. At the ends of each set of chains are attached chain spacer bars. A ratchet release film roller is attached

to the chain spacer bar. This provides ease of converting from conventional to stereo loop film threading. The accumulator chains are so adjusted that they are the same distance from center at all times. See Fig. 2.

SECTION 2

OPERATIONS

2.1 This section will cover the preparation and the operation of the MIM 6 (1540) Light Table.

2.2 PREPARATION/OPERATION

2.2.1 Remove packing and wrapping materials from light table and all accessories excepting the microscope bridge assemblies.

2.2.2 Plug the main power cord into any properly grounded convenience outlet providing 115 volts 50/60 cycle A.C. See Fig. 5.

CAUTION

To eliminate electrical shock hazards, this equipment is internally grounded and must be connected to a properly grounded power outlet. The use of adapter ("cheater") devices is not recommended. If a properly grounded outlet is not available, acquire competent electrical assistance before connecting equipment. Failure to follow these instructions voids equipment warranty and The [] accepts no responsibility for personal injury.

2.2.3 Elevate the viewing surface to a comfortable operating level. This can be accomplished one of two ways. ONE: Push the manual crank in and rotate it to the left or right until desired level is attained. See Fig. 5. TWO: Actuate the elevating switch, "RAISE/LOWER", located in the main control panel until desired level is attained. See Fig. 1.

2.3 REEL BRACKETS

2.3.1 The reel brackets are designed to permit handling and viewing of single or dual film strands in widths up to 9.5 inches. The installation of the reel brackets will be covered in steps 2.9 through 2.9.4.17 "FILM THREADING CONFIGURATIONS". The reel brackets consist of the following assemblies. See Fig. 3.

- 1 each - Left Hand Motor Drive Bracket
- 1 each - Right Hand Motor Drive Bracket
- 1 each - Left Hand Center Idler Bracket with Scale
- 1 each - Right Hand Center Idler Bracket with Scale
- 1 each - Left Hand Spindle Bracket
- 1 each - Right Hand Spindle Bracket
- 2 each - Left Hand Transporting Motors
- 2 each - Right Hand Transporting Motors
- 2 each - Manual Cranks
- 2 each - "T" Rails 16-1/4 inches long
- 2 each - "T" Rails 9 inches long

2.3.2 Each of the four "T" rails have a series of drilled holes and a scale numbering 70MM, 5.0", 6.6", and 9.5" for positive position-

ing of reel brackets. See Fig. 3.

2.3.3 Each of the reel brackets has a spring loaded plunger. When the plunger is depressed in the area of 70MM, 5.0", 6.6", or 9.5", it will engage with the drilled hole in the "T" rail, resulting in exact positioning of the reel bracket at one of the four settings desired. See Fig. 3.

2.3.4 Each of the two center idler brackets has a 70mm, 5.0", 6.6" and 9.5" scale attached. As the center idler is positioned, this scale is then used for positioning the motorized reel bracket or spindle bracket for dual film viewing. See Fig. 3.

2.3.5 Two manual film transporting cranks are provided. See Fig. 6 for crank storage location. If manual film transporting is desired, remove the cranks from storage location and engage crank pins in the drilled holes of the film drive motor hub. See Fig. 2.

2.3.6 The film transport motors are so arranged on the light table to accommodate the various film threading configurations. See Fig. 3.

2.3.7 All front and rear reel brackets are equipped with a manual retractable spindle. The retractable spindle permits the removal and installation of film reels without disturbing reel bracket location. See Fig. 3.

2.4 POWER/ILLUMINATION CONTROLS

2.4.1 Plug the main power cord into any properly grounded convenience outlet providing 115 volts 50/60 cycle A.C. See Fig. 5.

CAUTION

To eliminate electrical shock hazards, this equipment is internally grounded and must be connected to a properly grounded power outlet. The use of adapter ("cheater") devices is not recommended. If a properly grounded outlet is not available, acquire competent electrical assistance before connecting equipment. Failure to follow these instructions voids equipment warranty and The [redacted] accepts no responsibility for personal injury.

2.4.2 Place the main power switch in the "ON" position. The red neon light to the right of the main power switch will light when power is on. See Fig. 1.

NOTE

The main power switch must be "ON" before any power controls will operate.

2.4.3 The illumination of the light table is controlled by a left and right potentiometer "ON/OFF" switch assembly. To illuminate the viewing stages, rotate the switch knobs to the right. The dimming ratio of 30 to 1 (100 to 3000 ft. Lamberts) is attained by rotating the switch control knobs: Right to increase; left to decrease light intensity. Either viewing stage can be illuminated independently of the other. See Fig. 2.

CAUTION

To reduce eyestrain it is recommended that lamp intensity be reduced to the lowest level compatible with material being viewed.

NOTE

The lamp grid is initially energized to 80% of maximum illumination from a cold start and requires approximately 15 minutes to reach maximum light intensity with controls at highest setting.

2.5 FILM DRIVE CONTROLS

2.5.1 The film drive controls consist of a left and right control station, (see Fig. 2) and a selector switch for conventional or split vertical operation (see Fig. 1). The operation and setting of motor bi-directional switches will differ from one film threading configuration to another and will be covered in steps 2.9 through 2.9.4.17 (FILM THREADING CONFIGURATIONS).

2.5.2 The ON/OFF motor power toggle switches are located at the left and right control stations. The red neon light will light when power is on.

2.5.3 The "CONVENTIONAL/SPLIT VERTICAL" selector switch is an electrical transfer switch that performs as follows:

2.5.3.1 When set on "CONVENTIONAL", power is delivered to the left and right motorized reel brackets.

2.5.3.2 When set on "SPLIT VERTICAL", power is delivered to the left and right lower film transport motors. See Fig. 1.

2.5.4 The film drive speed controls are located at the left and right control stations. Each control operates two motors in various film threading configurations. When the control knob is positioned approximately center of its travel limits, a null position and balanced torque condition is attained. Null position and balance will vary as film is transferred from one spool to the other. The balanced torque

condition keeps the film under proper tension. By rotating the control knobs clockwise and counterclockwise, power is applied and reduced to the motors as required for proper transport speed. Individual motor control varies with the film threading configuration being used. See steps 2.9 through 2.9.4.18.

2.5.5 Motor bi-directional toggle switches are located on the left and right control station. The bi-directional toggle switch is of a double pole double throw type. When actuated, the motor changes direction of rotation. See Fig. 2.

WARNING

Do not reverse motor rotation with bi-directional switch while power is applied to the motor. This will result in the demagnetizing of motor stator, with resultant loss of motor torque. See step 2.5.2.

2.6 MICROSCOPE CARRIAGE

2.6.1 Remove packing and tie down materials from the microscope bridge assembly. Do not remove the filament tape securing the microscope ring "Z" travel (vertical) assemblies.

2.6.2 Place the four latching devices in an open position. See Fig. 4.

NOTE

To facilitate the installation of the microscope bridge assembly, it is suggested that the lifting and placement be accomplished by two people.

2.6.2.1 Grasp the bridge rails near the two rubber bumpers and install in position using the circular and the mating pieces as guides for proper alignment. See Fig. 4.

2.6.2.2 Secure microscope bridge in place with the four latches. See Fig. 4.

2.6.2.3 Remove the filament tape from microscope ring and "Z" travel assemblies.

2.6.2.4 Install microscope in the adapter ring and secure in place with the two locking knobs. See Fig. 4.

NOTE

For further adjustment of microscope, refer to manual supplied with optics.

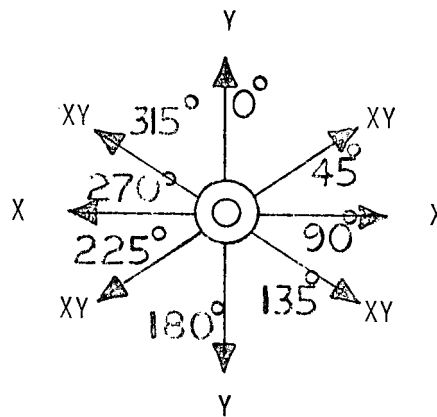
2.6.2.5 Connect the microscope bridge power cord to its receptacle. See Fig. 6.

2.7 MICROSCOPE BRIDGE CONTROLS

2.7.1 The microscope bridge "ON/OFF" switch and variable speed controls are located at the left side of the microscope vertical mount assembly. See Fig. 4.

2.7.1.1 The microscope bridge travel speed in the "X" and "Y" axis can be controlled by rotating the speed control knob left and right. See Fig. 4.

2.7.2 The microscope bridge "X" and "Y" fine feed travel is controlled by an eight direction "joy stick" thumb switch, located at the left rear of microscope adapter ring. By actuating the switch ("joy stick") in any one of the eight directions, (see diagram below) the microscope can be positioned at any point over the two viewing stages. See Fig. 4.



XY FINE FEED CONTROL SWITCH

2.7.3 The microscope bridge rapid "X" and "Y" manual travel is accomplished by depressing the decoupling switch located at the left rear side of the microscope vertical mount assembly. See Fig. 4. With the switch depressed, the microscope can be positioned "manually" at any point over the two viewing stages. To decouple the bridge completely from fine feed control place the bridge power switch (step 2.7.1) to the

"OFF" position.

2.7.4 The "Z" travel of the microscope is controlled manually by two knobs located on the left and right side of the vertical mount assembly. The coarse adjustment is the upper right knob. See Fig. 7. The fine adjustment is the lower left and right knobs. See Fig. 4.

2.7.4.1 The microscope may be elevated manually by raising the microscope ring mount.

2.8 STAGE SHIFTING

2.8.1 Two stage shifting handles are located at the front of the light table. See Fig. 2.

2.8.1.1 By shifting the viewing stages, left and right, this makes possible the various film threading configurations. See steps 2.9 through 2.9.4.17 (FILM THREADING CONFIGURATIONS).

2.9 FILM THREADING CONFIGURATIONS

2.9.1 Conventional Single Strand Threading:



2.9.1.1 Set selector switch to "Conventional".

2.9.1.2 Position the left and right spindle bracket (center idler bracket) on the upper "T" rails at 70MM, 5.0", 6.6", or 9.5", depending on the film size being viewed. Tighten black locking knobs on brackets.

NOTE

When single film strands are being viewed (in all threading configurations), and the operator is using the center idler bracket to support the film reels, it is necessary to provide lateral support. This can be accomplished by positioning the rear motorized bracket spindle against the rear center idler bearing.

2.9.1.3 Move the spring loaded spiral latch knobs (on the upper front right and left motor drive) downward, retracting the drive spindles. See Fig. 3.

2.9.1.4 Place supply reel in position engaging spool key slot hole with center idler spindle bearing.

2.9.1.5 Supporting the reel with one hand, move the spring loaded spiral latch on the upper (front) drive motor upward to the detent posi-

tion while aligning drive spindle with the reel key slot.

2.9.1.6 Repeat steps 2.9.1.4 and 2.9.1.5 for opposite side of light table for take up reel installation.

2.9.1.7 Feed film from the supply reel across the viewing stages and attach the free end to the take up reel.

2.9.1.8 Close the viewing stages by shifting the handles inward. See step 2.8.

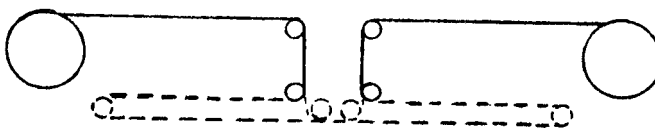
NOTE

The film loop accumulator rollers must be retracted before closing viewing stages.

2.9.1.9 Set the right front bi-directional switch to clockwise. Set the left front bi-directional switch to counter-clockwise.

2.9.1.10 See steps 2.4 through 2.5.6 for illumination and film drive controls. Film drive will be controlled from the right control station.

2.9.2 FILM THREADING: STEREO LOOP ACCUMULATION



2.9.2.1 Repeat steps 2.9.1.1 through 2.9.1.6

2.9.2.2 Open viewing stages by shifting the handles outward. See step 2.8.

2.9.2.3 Rotate the film loop accumulator knob counterclockwise until film loop rollers protrude approximately 3/4 inch above the viewing stages. Release the rollers at the front by pushing the quick release sleeve back, then swing the roller outward and to the rear of the table. See Fig. 6.

2.9.2.4 Feed film from supply reel across viewing stages and attach free end to take up reel.

2.9.2.5 Replace film loop rollers over the film securing at quick release end.

2.9.2.6 Rotate the film loop accumulator knob clockwise until the desired film take up is attained.

2.9.2.7 Repeat steps 2.9.1.9 and 2.9.1.10.

2.9.3 DUAL FILM THREADING: CONFIGURATION
2.9.3.1 Possible Dual Film Combinations

	<u>Front</u>	<u>Rear</u>
1.	70MM	70MM
2.	70MM	5.0"
3.	70MM	6.6"
4.	5.0"	70MM
5.	5.0"	5.0"
6.	5.0"	6.6"
7.	6.6"	70MM
8.	6.6"	5.0"
9.	6.6"	6.6"
10.	70MM	9-1/2"

2.9.3.2 Set selector switch to "Conventional".

2.9.3.3 Position center idler on the upper "T" rail for the size film being viewed at the front of the viewing stages. Tighten bracket locking knob.

2.9.3.4 Position the rear motorized reel bracket on the upper "T" rail for the size film being viewed at the rear of the viewing stages. Tighten bracket locking knob.

2.9.3.5 Repeat steps 2.9.3.3 and 2.9.3.4 for reel bracket installation on opposite side of light table.

2.9.3.6 Repeat steps 2.9.1.3 through 2.9.1.7.

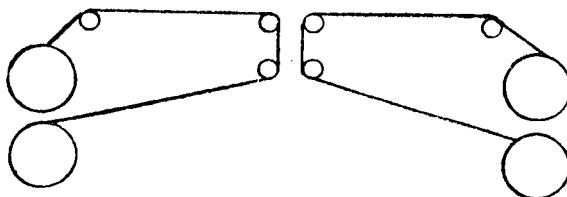
2.9.3.7 Set the bi-directional switches at the right control station as follows: Front - clockwise; Rear - clockwise. The right control station will control film transport of the front strand of film.

2.9.3.8 Set the bi-directional switches at the left control station as follows: Front - counter-clockwise; Rear - counter-clockwise. The left control station will control film transport of the rear strand of film.

2.9.3.9 See steps 2.4 through 2.5.6 for illumination and film drive controls.

2.9.3.10 See steps 1.4.1 through 1.4.3 for masking.

2.9.4 FILM THREADING: SPLIT VERTICAL



- 2.9.4.1 Set selector switch on "Split Vertical".
- 2.9.4.2 Position center idler bracket on the upper "T" rail at 70MM, 5.0", 6.6" or 9.5" depending on the film size being viewed. Tighten black locking knob on bracket.
- 2.9.4.3 Position spindle bracket on the lower "T" rail at the same setting as the center idler bracket on upper "T" rail.
- 2.9.4.4 Repeat steps 2.9.4.2 and 2.9.4.3 for reel bracket installation on opposite side of light table.
- 2.9.4.5 Release the bottom cover latches and lower bottom cover assembly. See Fig. 2.
- 2.9.4.6 Rotate the film accumulator knob clockwise to its stop.
- 2.9.4.7 Move the spiral latch knobs on both upper and lower front motor drives downward, retracting the drive spindles.
- 2.9.4.8 Move the left and right lower rear spindle spiral latch knobs upward to the detent position.
- 2.9.4.9 Place the supply reel in position at the upper transport motor. See steps 2.9.1.4 and 2.9.1.5.
- 2.9.4.10 Place the take-up reel in position at the lower transport motor. See steps 2.9.1.4 and 2.9.1.5.
- 2.9.4.11 Repeat steps 2.9.4.3 and 2.9.4.4 for installation of reels on opposite side of light table.
- 2.9.4.12 Open the viewing stages by shifting handles outward from center. See Fig. 2.
- 2.9.4.13 Feed film from the supply reel across one viewing stage, down through the stage separation, back under the viewing stage, attaching the free end to the lower take up reel.
- 2.9.4.14 Repeat step 2.9.4.12 for film threading on the opposite side of the light table.
- 2.9.4.15 At the right control station set the "FRONT" (upper) bi-directional switch to clockwise, and the lower bi-directional switch to counter-clockwise. The right control station will control the film for the right viewing stage.
- 2.9.4.16 At the left control station set the "FRONT" (upper) bi-directional switch to counter-clockwise and lower bi-directional switch to clockwise. The left control station will control the film for the left viewing stage.

2.9.4.17 Close the bottom cover securing in place with its latches.

2.9.4.18 See steps 2.4 through 2.5.6 for illumination and film drive controls.

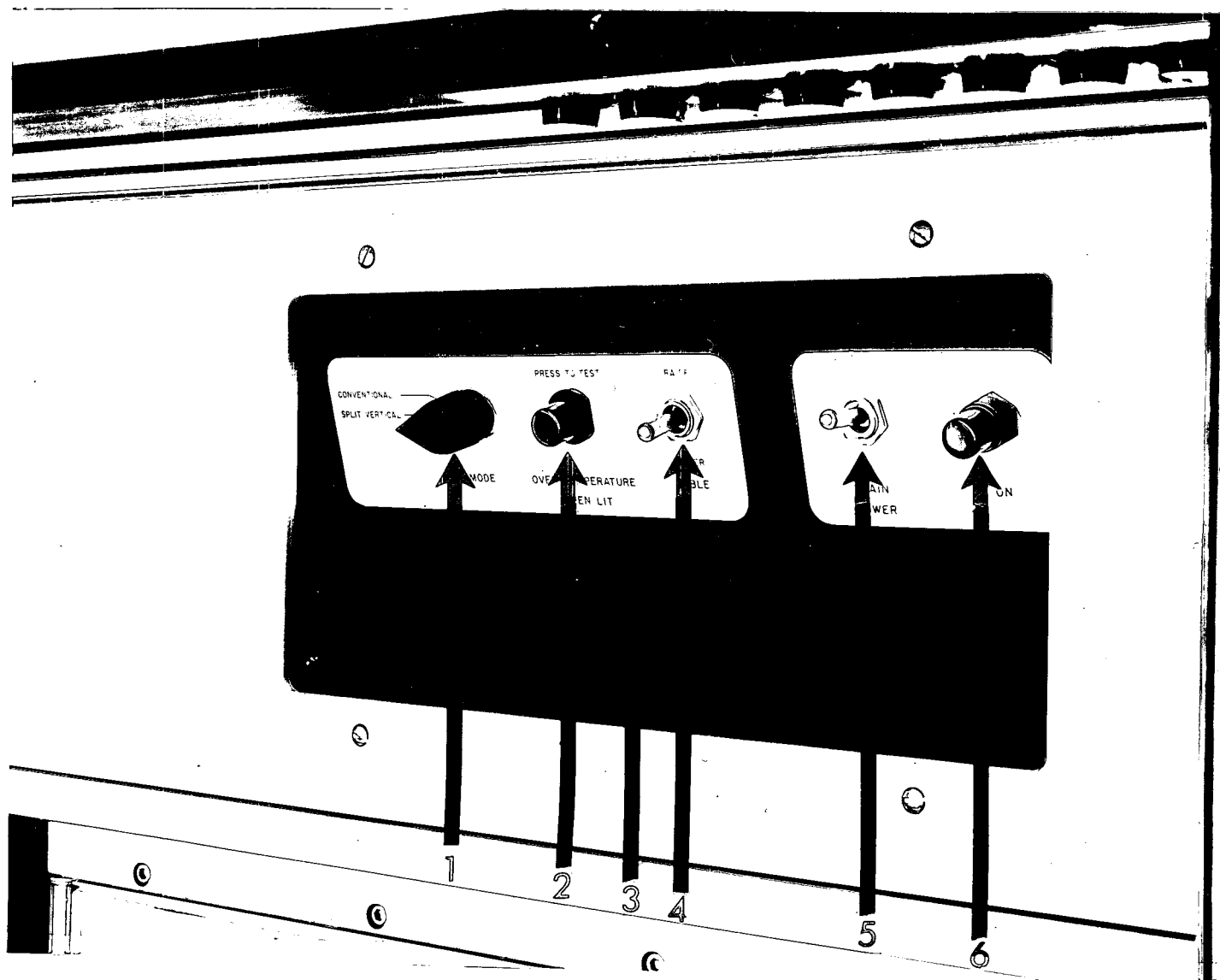


Figure 1

1. Conventional/Split Vertical Selector Switch
2. Over Temperature Light
3. Main Control Panel
4. Table Elevating Switch
5. Main Power Switch
6. Power On Pilot Light

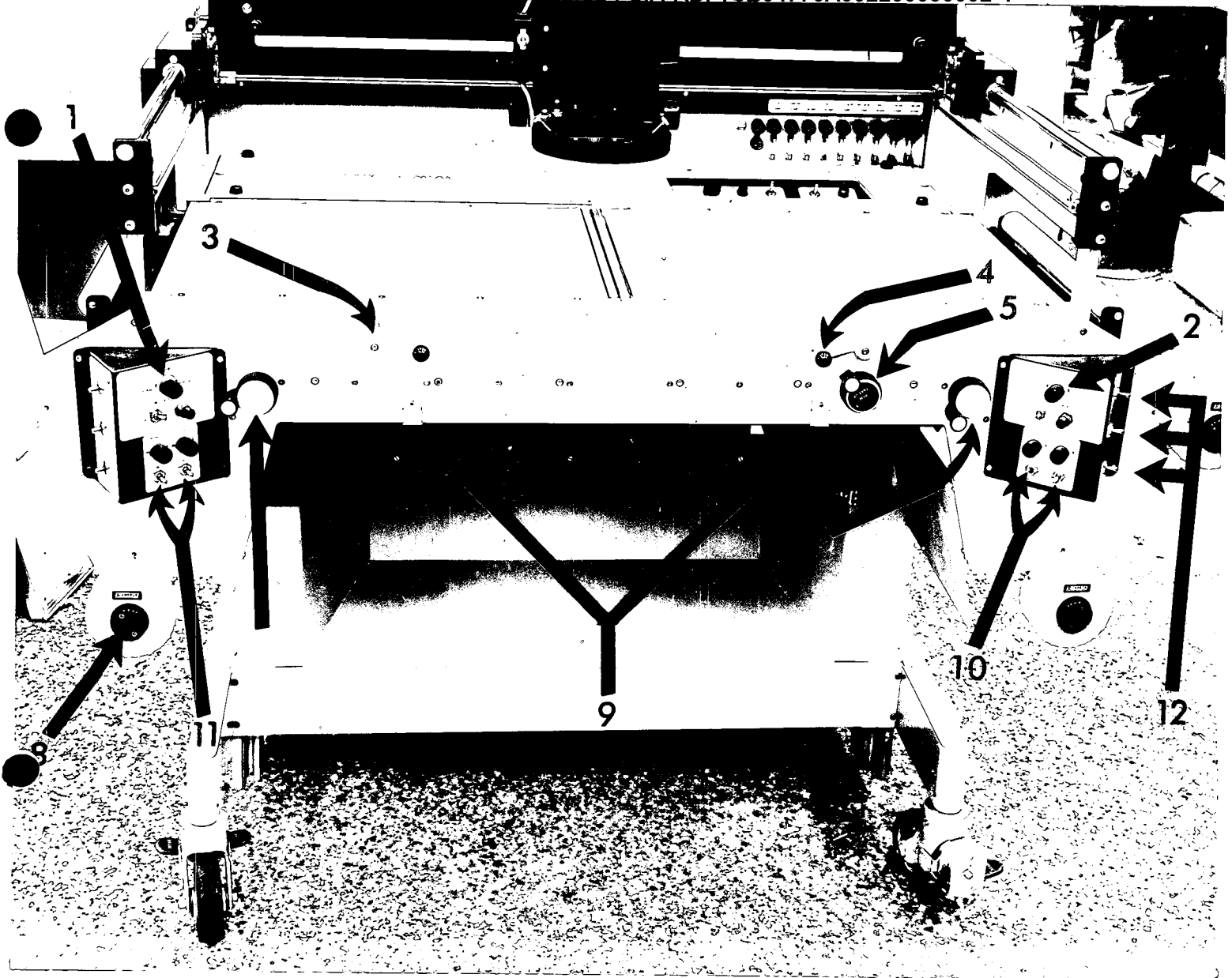


Figure 2

1. Left Control Station
2. Right Control Station
3. Left Stage Shifting Handle
4. Right Stage Shifting Handle
5. Film Accumulator Loop Knob
- 6.
- 7.
8. Manual Film Cranks
9. Bottom Cover Latches
10. Right Stage Illumination Switch
11. Left Stage Illumination Switch
12. Motor Bi-Directional Switches



Figure 3

- | | |
|---|-------------------------------------|
| 1. Front (Upper) Film Transport Motor | 6. Lower "T" Rail with Scale |
| 2. Lower Film Transport Motor | 7. Rear Motorized Reel Bracket |
| 3. Upper "T" Rail with Scale | 8. Film Roller |
| 4. Spindle Reel Bracket | 9. Spring Loader Spiral Latch Knobs |
| 5. Center Idler Reel Bracket with Scale | |

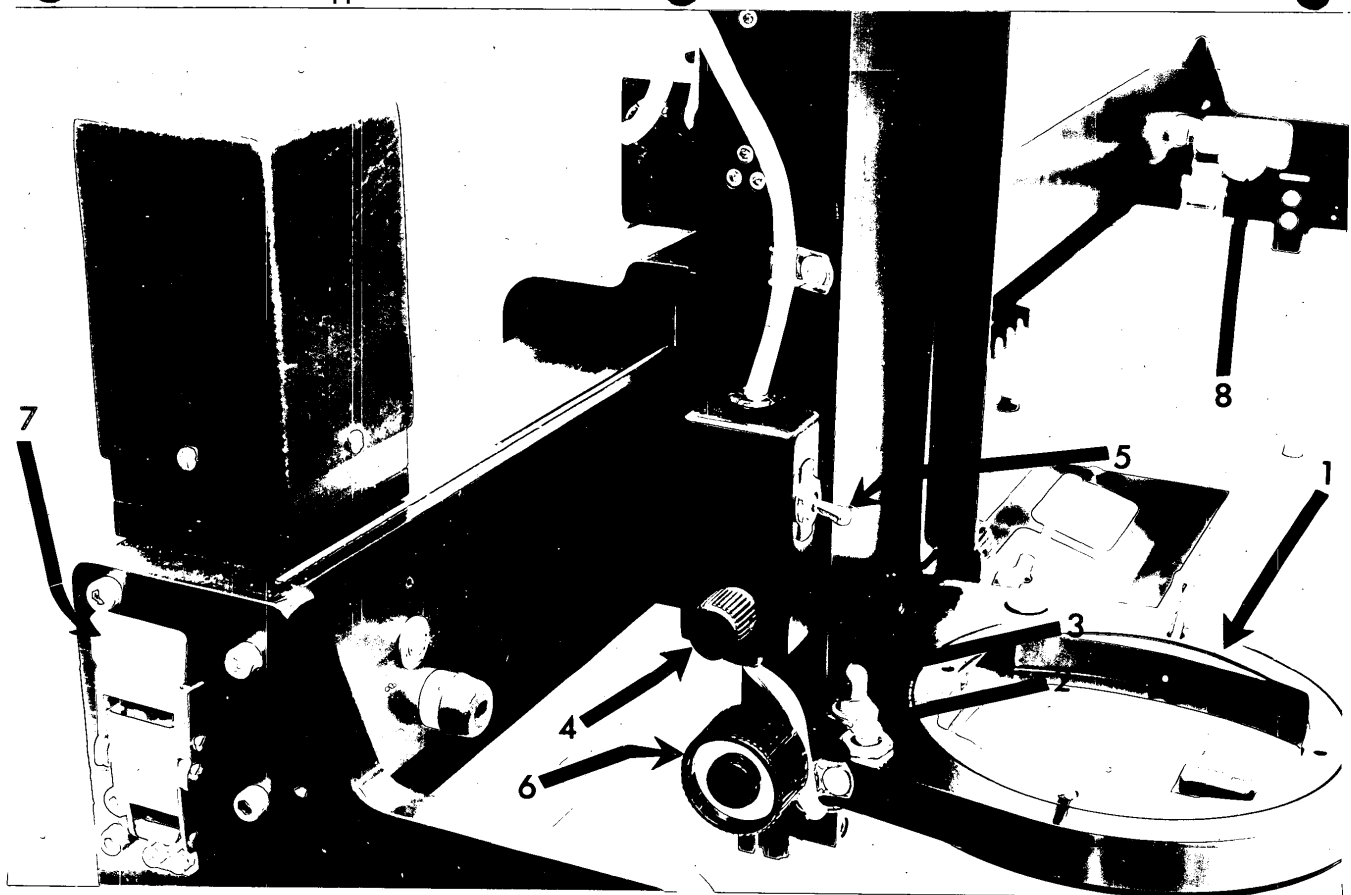


Figure 4

- | | |
|---|--------------------------|
| 1. Microscope Adaptor Ring | 5. Bridge Off/On Switch |
| 2. "X", "Y" Axis De-Coupling Switch | 6. Fine "Z" Travel Knob |
| 3. Eight Position "X" "Y" Axis Switch (Joy Stick) | 7. Bridge Latches |
| 4. "X", "Y" Axis Speed Control | 8. Mating Circular Guide |

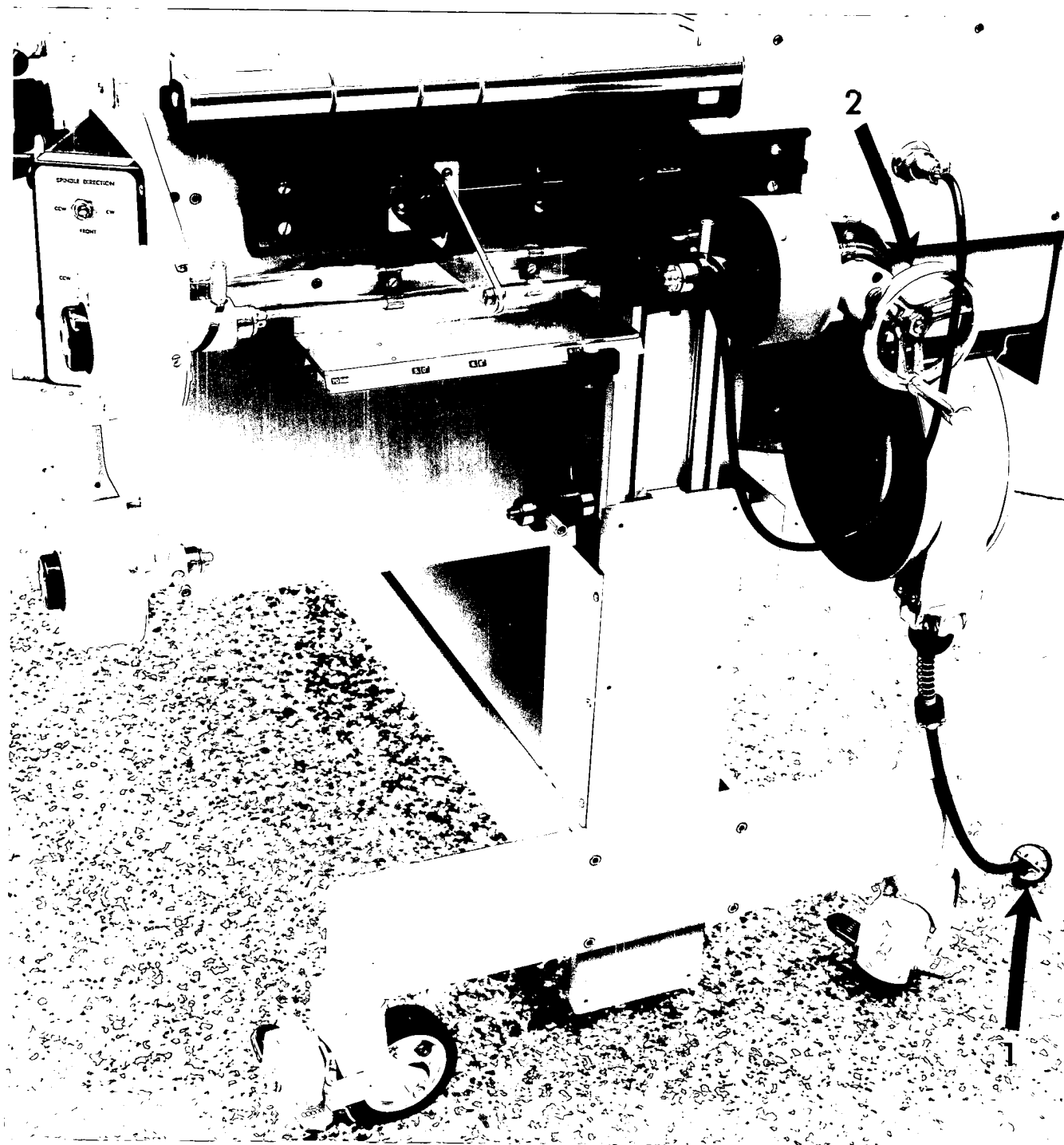


Figure 5

1. Main Power Cord
2. Manual Elevating Crank

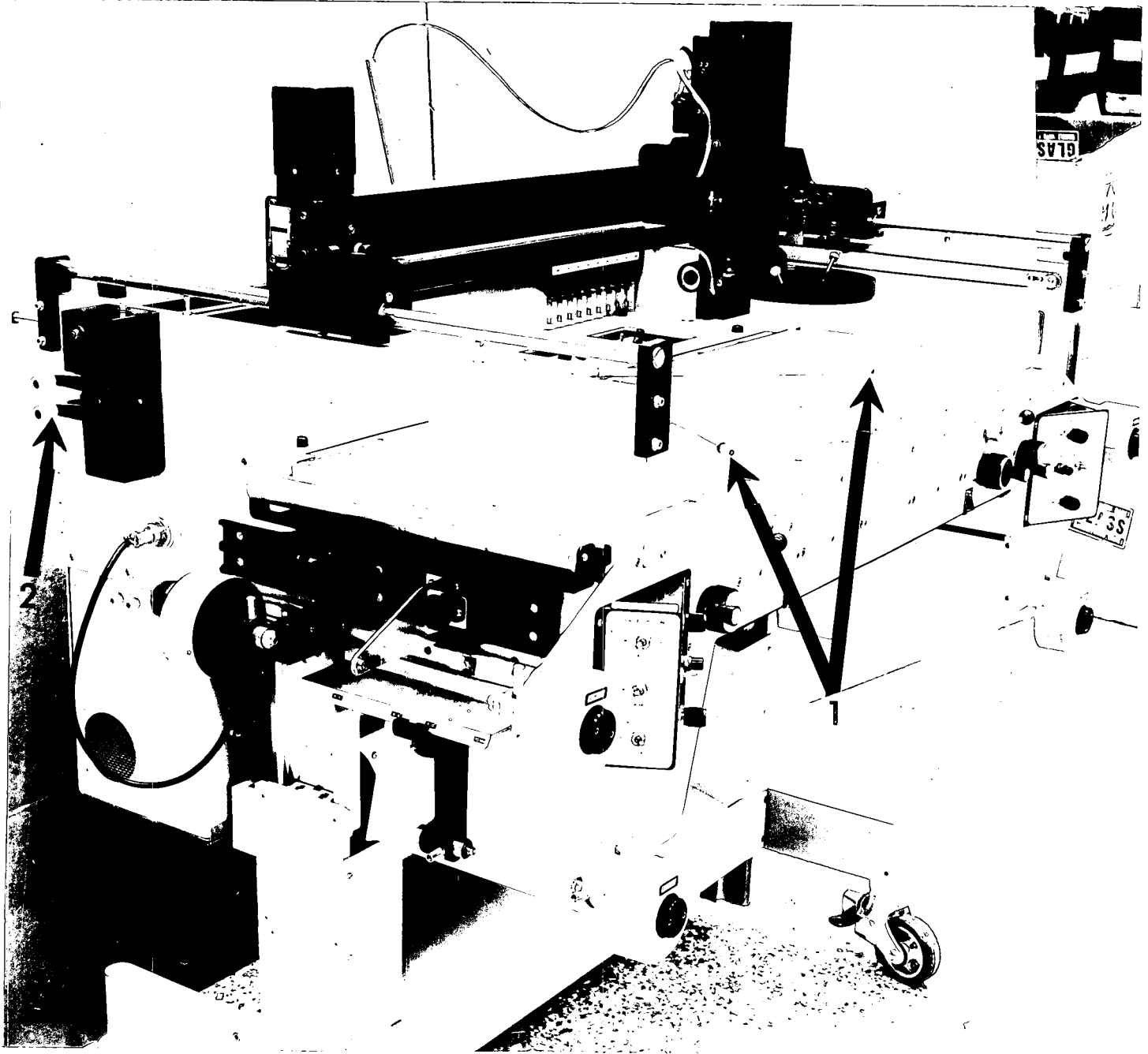


Figure 6

1. Film Loop Accumulator Rollers
2. Manual Crank Storage

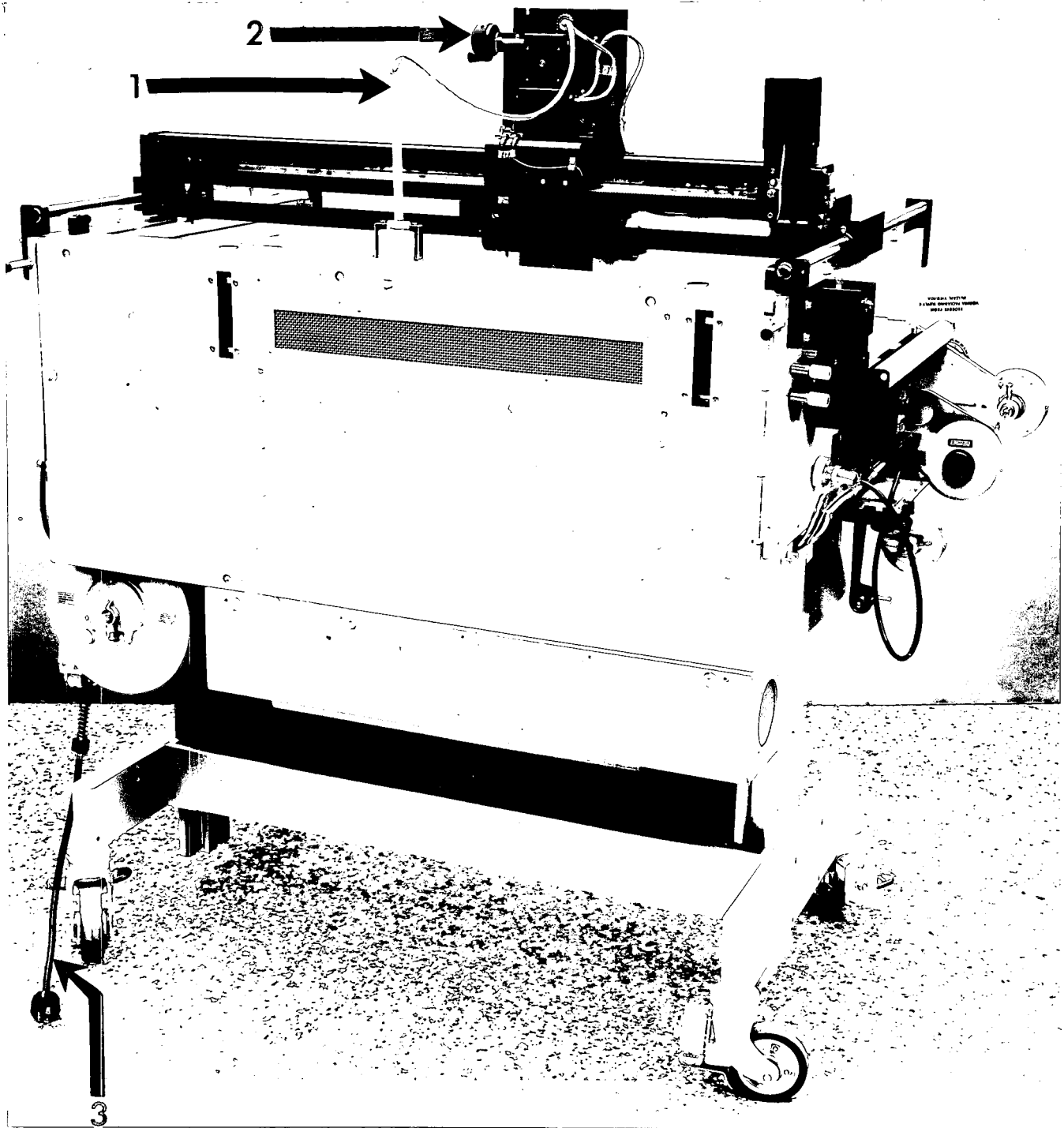


Figure 7

1. Bridge Power Cord
2. Course "Z" Travel Knob
3. Main Power Cord

MAINTENANCE

3.1 GENERAL:

This section will cover circuitry theory; mechanical adjustments and trouble shooting.

As in all film handling equipment, the most important phase of a maintenance program are: personnel properly trained in operation, daily inspection and cleaning of the equipment. The close adherence to these phases will result in an efficient piece of equipment requiring a minimum of maintenance.

3.2 CIRCUITRY THEORY

3.2.1 ILLUMINATION CIRCUITRY:

For this discussion, one lamp circuit will be described in general terms.

3.2.1.1 The stage is lighted by four separate sections of light grids. Each section is separately controlled as to intensity. Power is applied for each section individually through the switch on the intensity control. The switch actuates a double pole relay, one pole of which applies power to the cooling system. The other pole applies power to the dimmer circuit and the transformers which apply the appropriate voltage to the grid itself. The dimmer circuitry consists of a pair of silicone controlled rectifiers (SCR'S) and the appropriate triggering circuit. The intensity control adjusts the timing circuit to cause the SCR'S to be triggered at the selected point for a given intensity setting. The high limit and low limit calibrating resistors are used in conjunction with the intensity control to prevent excessive power being delivered to the lamps (High Limit) or to prevent the lamp from flickering or extinguishing at the very low levels (Low Limit).

3.2.2 COOLING SYSTEM CIRCUITRY

The lamps are immersed in an oil coolant which carries off the generated heat. When any of the lamp circuit OFF/ON switches are in the on position, power is applied through fuse F-5 to the fan B-1 and B-2 and to pump B-3 which receives partial voltage as set by variable transformer T-1. Pump B-3 circulates the oil through the lamps and heat exchanger where the air from the fans transfers the heat to the surrounding air. Lamp DS-2 is an over temperature indicator. Thermostats S-12 and S-13 are located inside of the light grid assembly. DS-2 will glow to indicate an over temperature condition in the lamps.

3.2.3 CARRIAGE DRIVE CIRCUITRY:

3.2.3.1 Power is applied to carriage drive holding clutches L-1 and L-2 through transformer T-2 and through fuse F-7 when any section of the lamp grids is on. Circuit can be interrupted indefinitely by switch S-10 or intermittently by button switch S-11 for free wheeling of carriage. When switch S-10 is closed power is also applied through switch S-22 from motor controller A-6.

3.2.3.2 Joy stick switch S-22 applies the output of motor controller through diodes CR17 or 18 to motor B-4 (Y axis) and through CR16 or 19 to B-5 (X axis). Switch S-22 can be manipulated to select any one or two adjacent contacts, thereby applying power to B-4 and/or B-5 with the proper polarity to drive the carriage in direction selected by switch S-22. The speed of drive is controlled by R-19. Resistor R-18 adjusts the speed control limit.

3.2.4 ELEVATING CIRCUITRY:

3.2.4.1 Power is applied to through fuse F-11 to switch S-21 which applies power to bridge rectifier CR-2 and subsequently supplies the D.C. output of the bridge rectifier to the elevator motor B-12. The polarity on the field winding is maintained while the polarity of the armature is reversed when S-21 is actuated alternately. Power is also applied through dropping resistors R-21 and R-22 to clutch L-3.

3.2.5 FILM DRIVE CIRCUITRY:

3.2.5.1 Each film track transport consists of a pair of motors pulling in opposition through the film. When the film is stationary the power applied to a motor, and the film diameter relationship is such that it causes the same tension as supplied by the opposing motor. (Torque #1 times diameter #1 = Torque #2 times diameter #2). To transport in either direction the power input to the "takeup" motor is increased at the same time that the power to the "pay-out" motor is decreased. This upsets the previously given torque, diameter, balance and results in film motion. To cause the two power levels to shift simultaneously, a control voltage picked from the transport control is applied to the base of a PNP and a NPN transistor, each of which then feeds the base of a power transistor which controls motor power. The opposite characteristics of the two types of transistors provide the desired results.

3.2.5.2 A dual voltage, 100 volt and 50 volt power supply, supplies the power for motor operation (100 volt) and for the control circuitry. Simultaneously 50 volts is applied through a dropping resistor to a reference diode to supply the regulated 20 volts for the controls.

3.2.5.3 The pay-out motor, usually thought of as idling is being turned in the reverse direction by the film and is acting as a generator. The speed of this motor, as the film diameter decreases, will exceed the normal maximum speed rating of the motor and since the motor is acting as a generator the generated voltage may easily exceed the safe motor voltage rating. A resistor-diode network is connected across each motor, with the proper polarity, to apply a load which will tend to maintain the pay-out motor speed within safe limits. The slowing of the film toward the very end will be apparent when over 500 feet is transported at high speeds.

3.2.5.4 The "Conventional"/Split-vertical modes of operation require that the controller-motor relationships be switched between the two

motors. In either mode each controller circuit is associated with a pair of motors. The 100 volt power must also be switched to give complete operation control.

NOTE

The 50 volt control power is applied to both circuits when either circuit is turned on.

3.2.5.5 Graph #1 depicts the motor power as a function of the control potentiometer position. The central area of the graph is that which is normally used for zero or slow film transport while the extremes are for high speed transport. The transition from the low power to high power is accomplished by the resistor-reference diode network associated with the two low power transistors on the circuit board. When the voltage drop across the resistors equals the reference zener diode voltage, that diode provides a relative low impedance path for current flow. The network looks like a resistor until the voltage equals the zener voltage, then it appears as a diode.

3.3 MECHANICAL ADJUSTMENTS AND REPLACEMENTS

3.3.1 FILM LOOP ACCUMULATOR:

The looping assembly rollers should remain parallel and on same level to each other for proper operation. To correct parallelism or height difference; rotate accumulator knob until rollers are above stage level. Insert a flat sturdy material, i.e. clipboard, plexiglas, plywood etc., between rollers and stage surface.

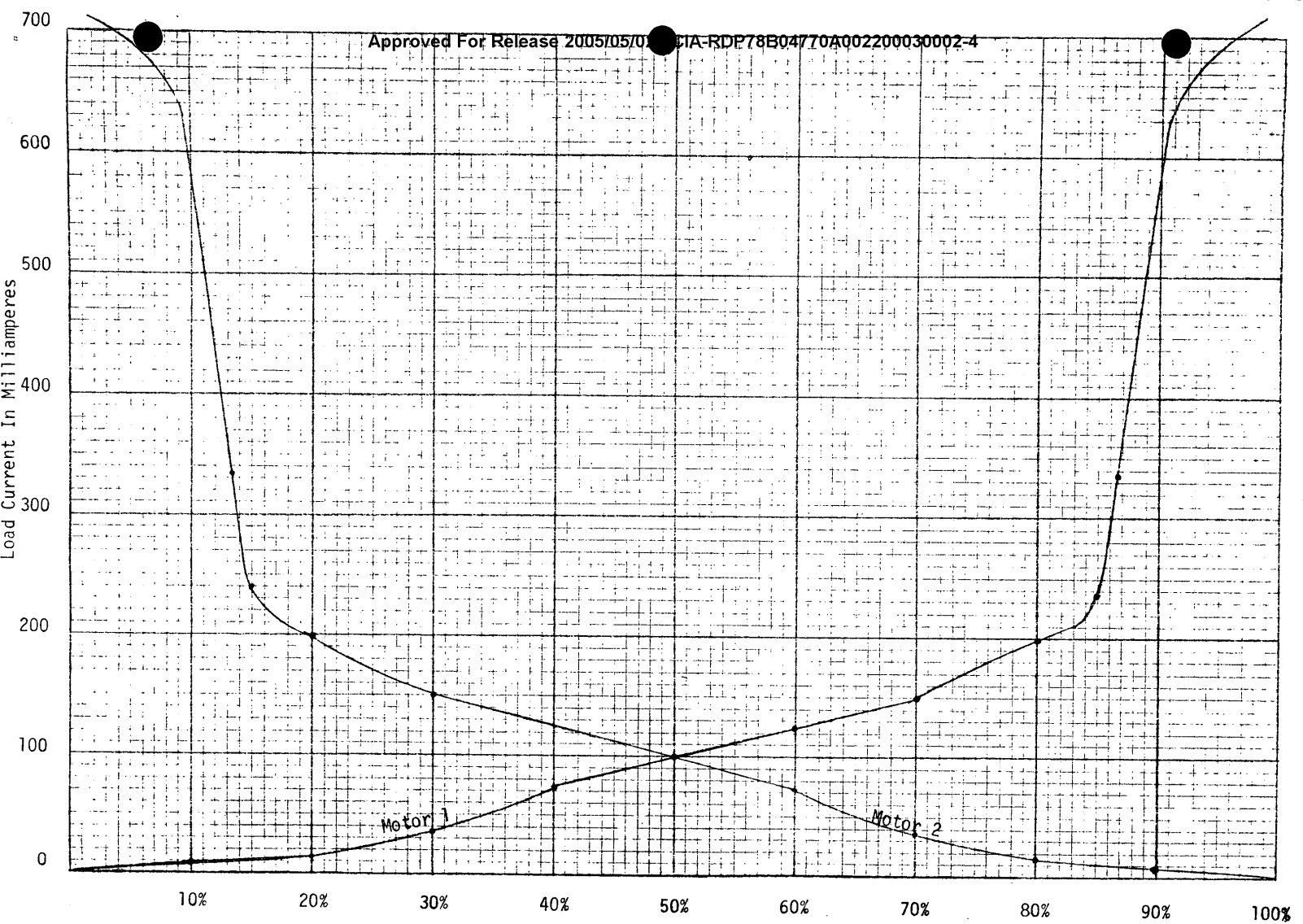
- a. For height difference in rollers remove power box cover at rear of viewing stage and release the shaft coupler located at right side of electrical compartment. Rotate accumulator knob to pull rollers snug against the inserted flat material. Tighten shaft coupler.
- b. To correct parallelism of the two rollers; lower the bottom film cover and release one of the two shaft couplers at the end of table of affected roller. Rotate accumulator knob to pull rollers snug against inserted material. Tighten shaft coupler.

3.3.2 MICROSCOPE CARRIAGE:

See section 2.6 for installation and removal of bridge.

3.3.2.1 Electrical connector blocks supply the power for the carriage drives and clutches by the use of brush pins and bus bars located at the ends and rear of carriage. A loss of power on bridge motors or clutches may indicate an adjustment of brush pins is required.

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GRAPH ONE

NOTE

Before adjusting brush pins; release carriage latches and reseat carriage to insure proper connection. Further, inspect bus bars for dirt, grime etc, if required clean bus bars with a mild detergent solution and dry thoroughly.

To adjust the brush pins, remove the carriage from the light table and proceed as follows:

Loosen the contact pin lock nuts and adjust the pin lengths to $11/32$ ($\pm 1/32$) from the base of the connector block to the head of the contact pin. Tighten lock nut and check adjustment.

3.3.3 LIGHT GRID REPLACEMENT

NOTE

Before replacing a light grid it is recommended that a thorough circuit check be conducted to completely eliminate the possibility of other component failure being the source of trouble.

In removing a light grid it is necessary to evacuate the oil from the cooling system. To properly accomplish evacuation you will need the following: A suitable container for the used oil, a two to three foot section of 7/16 I.D. flexible hose, four 6 inch sections of 2 x 4 blocks, valve core tool and eight 3/8 inch rubber stoppers.

3.3.3.1 Remove the electrical compartment cover.

3.3.3.2 Connect the valve core tool and the 7/16 flexible hose to either of the brass fittings below item 2 figure 6. Also use the drain line with pet cock located inside the electrical compartment at the rear of equipment. Start the circulating pump to expedite evacuation of oil.

Block the rear casters with two of the 2 x 4 blocks. Elevate the front of the light table and place the remaining 2 x 4 blocks under the front casters.

Remove the two valve cores from the light grid vent line at the rear of the light table.

Evacuate as much oil as possible.

3.3.3.3 Remove the front and rear viewing stage retainer strips.

CAUTION

Do not remove the socket head screws in the stage tops. Removal of screws will destroy the parallelism of the carriage and stage surface.

Carefully remove stage assembly by lifting up evenly the rear and front.

NOTE

At the rear of each grid is a series of two coiled springs with cables attached, which control the masks and center strips. Each of these springs and cables should be marked separately for identification for reassembly.

3.3.3.4 Remove the oil lines from the light grid. Plug lines and grid with 3/8 inch plugs.

Remove grid vent lines at the valve core and tie off.

Mark the high voltage and thermostat wires and grid connectors to aid in proper connection on reassembly. Unsolder all six wires.

Lower the bottom pan cover and remove the four socket head screws securing the grid pan to the plate. Loosen but do not remove the four rear socket head screws.

Remove the grid by raising at front and moving grid forward.

3.3.3.5 LIGHT GRID INSTALLATION.

Place grid in table and secure by replacing and tightening the eight socket head screws.

Connect high voltage and thermostat wires.

Remove rubber plugs from oil lines and reconnect lines to grid inlet and outlet pipes.

Replace grid vent line at valve core stem.

Remove the two plugs at top of heat exchanger cover.

Refill system through reservoir cups.

NOTE

The oil circulating pump may be used to expedite refilling of the system. However, the line used to drain the system will have to be hooked up to the opposite brass fitting.

It may be necessary to elevate one side of the table to vent all air from the grid.

NOTE

Refill with Pennsylvania Refining Company "Penetec" White Mineral Oil, 38/40 viscosity, U.S.P.

Replace all valve cores after air is vented.

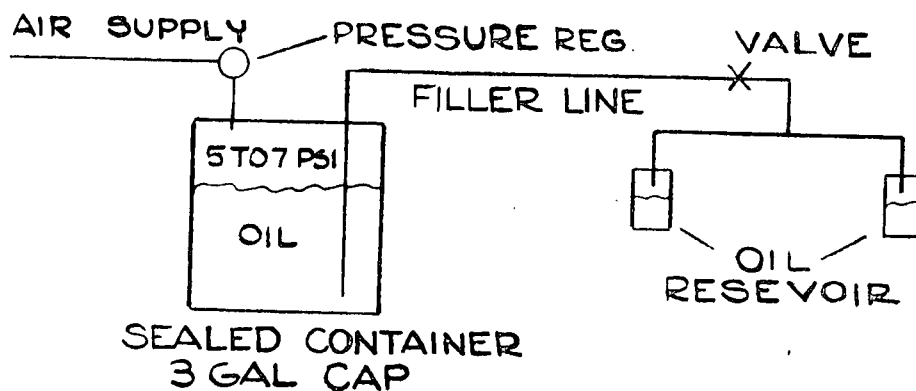
Hook up masking assemblies in sequence of disassembly.

Replace viewing stage and secure with front and rear retainer strips.

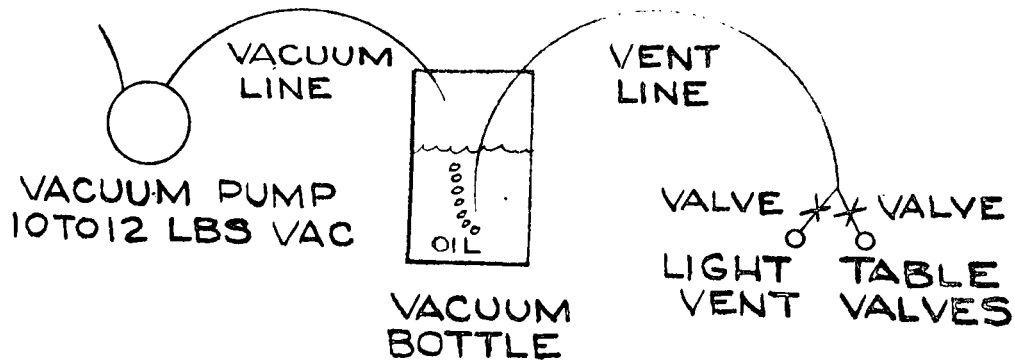
Replace electrical pan cover.

3.3.3.6

PRESSURE FILLING OF SYSTEM, IF REQUIRED.
See Diagram Below.



3.3.3.7 VACUUM VENTING OF SYSTEM, IF REQUIRED.
See Diagram Below.



3.3.4 VIEWING STAGE DISASSEMBLY: FOR CLEANING AND GLASS REPLACEMENT.

3.3.4.1 Remove the electrical compartment cover at rear of viewing stage.

Remove front and rear retainer strips.

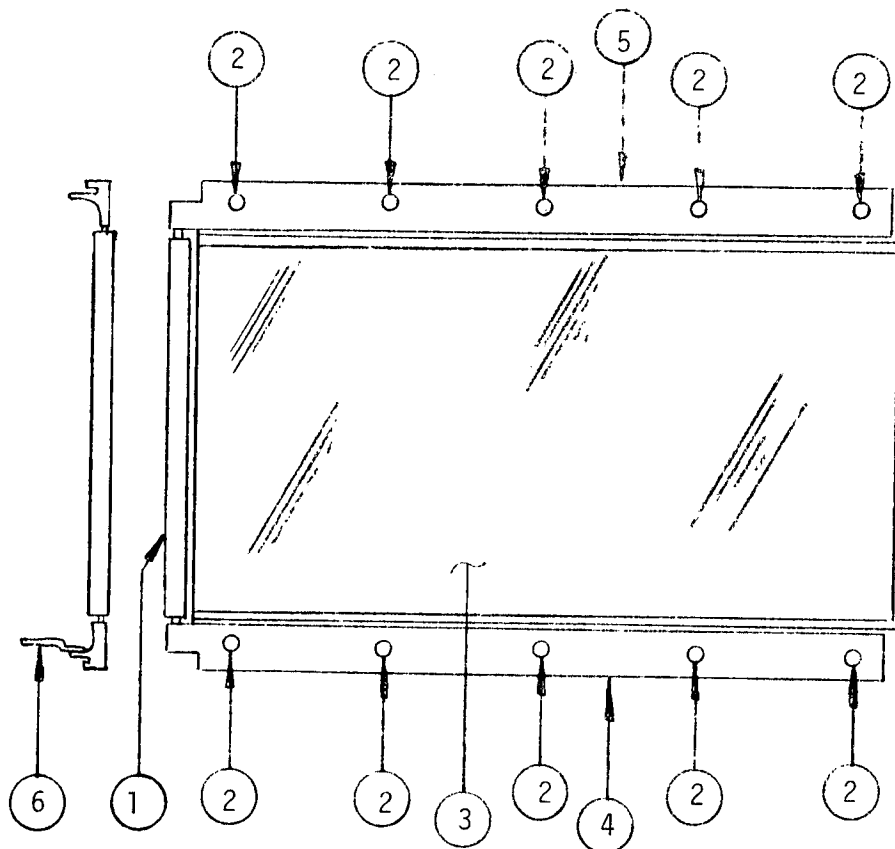
Place stage shifting handles in a vertical position.

Remove stage by lifting from center up and out. Mark stage guides with respect to glass surface to which attached.

Remove the ten socket head screws, item 2 dwg 1, and remove stage guides.

NOTE

When removing the stage guides care should be taken to remove the film rollers in complete assembly.



DRAWING 1

1. Roller Assy
2. Adjustment Screw
3. Safety Glass
4. Front Stage Guide
5. Rear Stage Guide
6. Stage Cam Shifter

3.3.4.2 To remove diffuser from stage glass assembly; insert a razor blade between the diffuser and safety glass, dwg 2 item 1 and dwg 2 item 6, to break seal.

Slide diffuser out of stage mounting strips. Dwg 2 items 4 and 5.

3.3.4.3 To remove plate glass; insert a razor blade between the glass and mounting strips to break seal. Dwg 2 items 4, 5 and 7.

CAUTION

Do not bend the mounting strips. Collimation cannot be attained on reassembly if strips are damaged.

Remove the black rubber cushion strips, dwg 2 item 8, from the mounting strips. Dwg 2 items 4 and 5.

3.3.4.4 STAGE ASSEMBLY
Place the eight adhesive spacers as shown in dwg 2 item 3 on the inner flange of the stage strips.

Thoroughly clean the glass and diffuser.

Apply sparingly General Electric RTV102 Sealant to the inner flange of the stage strips.

Place the glass in the stage guide strips. Be sure to seal the glass in place by pressing down in a circular motion. Slide the side strips away from the end strip.

Place a weight (approx 10 lbs) on the glass and let set for 24 hours.

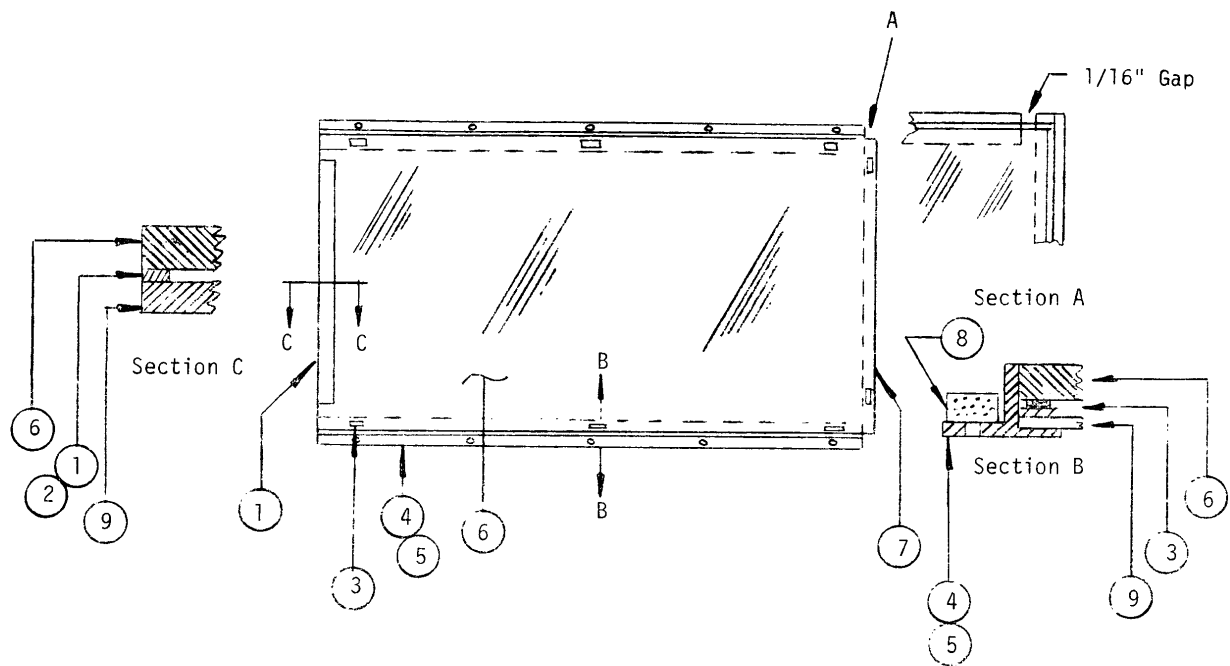
After sealant has set remove excess with razor blade.

Center the diffuser spacer, dwg 2 item 1, at one end of the diffuser, dwg 2 item 9, sealing it in place with methylene chloride.

Slide the diffuser plate in the stage strips and seal the open end with methylene chloride.

Place new black rubber cushion strips on the lower sides of the stage strips.

Install one stage guide on the stage glass assembly and tighten the five socket head screws finger tight, see dwg 1.



DRAWING 2

1. Spacer Diffuser
2. Methylene Chloride
3. Spacer Diffuser Blocks
4. Strip Stage Glass Mounting
5. Strip Stage Glass Mounting

6. Safety Glass
7. Cap Stage End
8. Cushion Strip
9. Diffuser Plate

Install the film roller assembly, see dwg 1, and remaining stage guide.

Place stage shifting handles in vertical position and install viewing stage assembly. Actuate stage shifting handles to insure proper seating of stage.

Replace front and rear retainer strips.

3.4.4.5 VIEWING STAGE PARALLELISM ADJUSTMENT.

Utilizing a dial indicator attached to the microscope adapter ring, make the following adjustments to insure parallelism between the carriage and viewing stage. The ten socket head screws on each stage assembly is used to adjust the viewing stage plane.

Place indicator anvil on the front top edge of roller assembly and zero. Move microscope mount and indicator in "X" direction until anvil rests on glass stage. Tighten front socket head screws until a minus .020 is attained.

Repeat at rear of stage.

When minus .020 is attained between roller assembly and stage glass, zero dial indicator with anvil resting on stage glass. Move microscope mount and indicator, from area of roller assy, along the "X" and "Y" axis and tighten or loosen the ten socket head screws until the viewing surface is within a \pm .005.

Replace electrical compartment cover.

3.4.5 MOTORIZED FILM DRIVE ASSEMBLY

The motor drives require no lubrication and only limited maintenance can be performed on the torque motors.

3.4.5.1 DRIVE ASSY DISASSEMBLY.

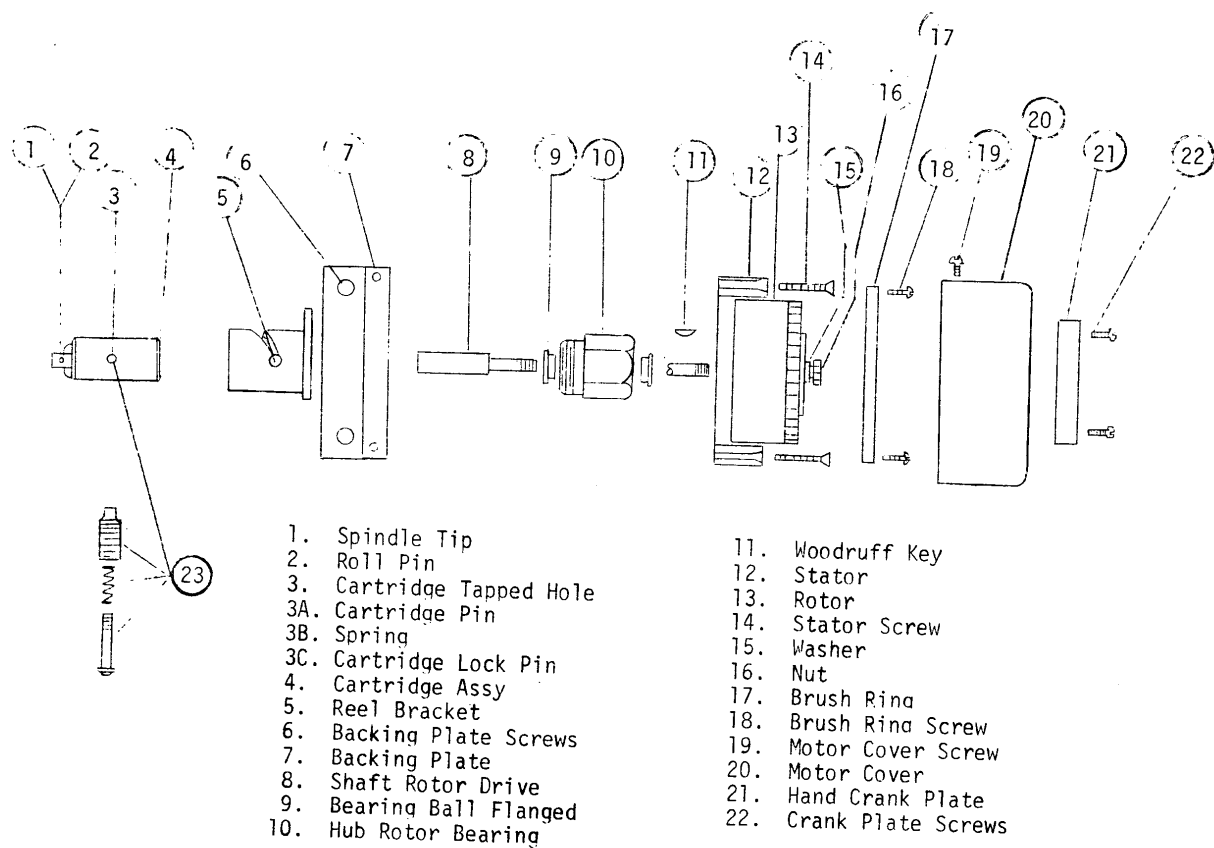
Reference Dwg 3.

Remove control station (Fig 2, item 1 or 2) and disconnect the black and red wires from center poles of the bi-directional switch of the affected motor.

Remove hand crank screws and hand crank plate (21 and 22).

Remove cover screws and cover (19 and 20).

Remove screws (18) securing the brush ring (17) and screws (14) securing the stator.



DRAWING 3

CAUTION

Do not separate the rotor (13) and stator (12). Separation will result in loss of magnetic power and cause a loss of torque. If the special keeper ring that allows rotor and stator separation is not available it is recommended that the rotor and stator be taped together to prevent accidental separation.

Remove woodruff key (11).

Remove screws (6) securing backing plate (7) to front plate.

Remove screw, spring and spirol latch knob (23). The rotor drive shaft (8) can now be removed.

Remove the rotor shaft bearing hub (10) from the backing plate (7).

Secure the hub in a suitable holding device and with a drift pin and small hammer gently tap the bearings (9) from the inside of the hub out. Do not try to drive bearings through the hub.

Clean all parts thoroughly and inspect for worn or damaged parts.

3.4.5.2 DRIVE ASSEMBLY REASSEMBLY.
Reference Dwg 3.

Install bearings (9) in the rotor shaft bearing hub (9), with bearing flanges to the outside, with a suitable press or brass drift.

Secure the motor backing plate (7) to the equipment front plate.

Install the bearing hub through the backing plate into the reel bracket arm (5) and tighten to 35 foot lbs torque.

Install the rotor drive shaft (8) from the inboard side of the reel bracket arm (5) through the backing plate and bearing hub.

Install woodruff key (11) in the slot of the rotor drive shaft (8).

Install rotor (13) and stator (12) as an assembly and align rotor key slot with woodruff key (11).

Install washer (15) with flat side to the rotor and nut. Tighten finger tight.

Rotate stator (12) by hand, aligning screw holes with tapped holes in backing plate. Do not tighten.

With a 1/4 drive tool inserted in the drive end of the rotor shaft (8), tighten stator nut (16) until all end play is removed. Do not overload bearings.

Shift the stator (12) slightly by tapping gently with a soft mallet until the rotor turns freely. To aid in the adjustment, a piece of 6 mil thick film and long enough to encircle the rotor may be used as a spacer between the stator and rotor.

CAUTION

Soft metals and other coatings are used on the torque motors. Care should be taken to prevent marring or distortion.

When rotor is adjusted for free movement tighten the 4 screws (14), securing the stator to the backing plate.

Install brush ring (17) aligning the stenciled numbers 1 and 2 on the stator and brush ring. Install and tighten brush ring screws (18).

CAUTION

To prevent distortion of the brush spring assemblies, do not deflect or use a holding device on the springs. Incorrect brush pressure on the commutator will cause faulty operation and excessive wear.

Replace motor cover (20) and secure with screws (19).

Replace hand crank plate (21) and secure with screws (22).

Replace drive cartridge assembly (4) and install screw, spring and spirol latching knob (23).

Reconnect the black and red wires to the center poles of the bi-directional switch.

3.5.1 LAMP CIRCUITRY: To trouble shoot a section of the light source which is malfunctioning, determine by schematic R-18270 the components involved for the particular section. For example, consider far right section

WARNING

Transformer secondaries are capable of supplying lethal voltages. Do not attempt to measure secondaries. Connections to any transformer terminal should be made with power off.

PROBLEM	PROBABLE CAUSE	REMEDY
Lamp fails to light.	<ol style="list-style-type: none"> 1. Fuse F1 2. Transformers, T9 or T10 3. Relay K1 4. Control circuitry for A1 dimmer circuit. 	<ol style="list-style-type: none"> 1. Inspect and replace if required. 2. Inspect transformer bank visually for signs of smoke or odor. Attach VM to transformer primary T9 or T10, 115 volts present indicates open transformer or faulty light grid. These components must be replaced temporarily to determine which is at fault. Replace as required. 3. Observe whether relay K1 is actuating when the OFF/ON intensity control is operated (Main Power Switch must be on). Replace if faulty. 4. To check; by-pass by jumping yellow and white/orange wires together. Lamp should ignite to full intensity with no dimming control effect. This indicates trouble in the calibrating and intensity control potentiometer circuit. Check for open potentiometers broken wires, etc. If above did not ignite the lamp remove the yellow and white/orange jumper and jump the brown and green wires together. If lamp ignites it indicates a faulty dimmer circuit. Replace.

3.5.2 COOLING SYSTEM: Should lamp DS2 indicate over temperature consistently or often the ventilating system should be checked and cleaned of dust accumulation.

PROBLEM	PROBABLE CAUSE	REMEDY
Lamp DS2 remains on and ventilating system is clean.	1. Pump B3 2. Transformer T1	1. Check visually for operation. 2. Read output voltage. Should be 65 volts. Replace if not operating at 65 volts.
	3. Fans B1 and B2	3. Check visually for operation.

CAUTION

Do not advance transformer T1 voltage beyond 70 volts.

- 3.5.3 CARRIAGE DRIVE: At least one light grid section must be lighted to power carriage components.

PROBLEM	PROBABLE CAUSE	REMEDY
a. Failure of carriage to lock in position.	<ol style="list-style-type: none"> 1. Bus Bars 2. Brushes 3. Fuse F7 4. Diode bridge CR1 5. Clutch coils L1 and L2 	<ol style="list-style-type: none"> 1. Inspect and clean contact surface, See Paragraph 3.3.2.1. 2. Check for wear and proper seating. See Paragraph 3.3.2.1. 3. Check and replace if required. 4. Check output voltage. Should be approx. 12 volts D.C. If voltage is low check capacitors C3 and C4. 5. Check coils for continuity. Replace if required.
b. Motorized carriage drives inoperative.	<ol style="list-style-type: none"> 1. Fuse F8 2. Motor Controller A6 3. Motors B4 and B5 	<ol style="list-style-type: none"> 1. Check and replace if required. 2. Check by reading AC output between green wire and machine neutral. (Not ground). Should be variable from 1.5 volts to at least 25 volts depending on setting of resistor R19. Replace if faulty. 3. Check D.C. voltage at motors B4 and B5. Should be 1.5 to 30 volts depending on setting of R19. Check continuity of B4 and B5. Replace as required.

NOTE

Polarity will reverse when switch S22 is thrown in opposite position.

3.5.4 ELEVATING SYSTEM:

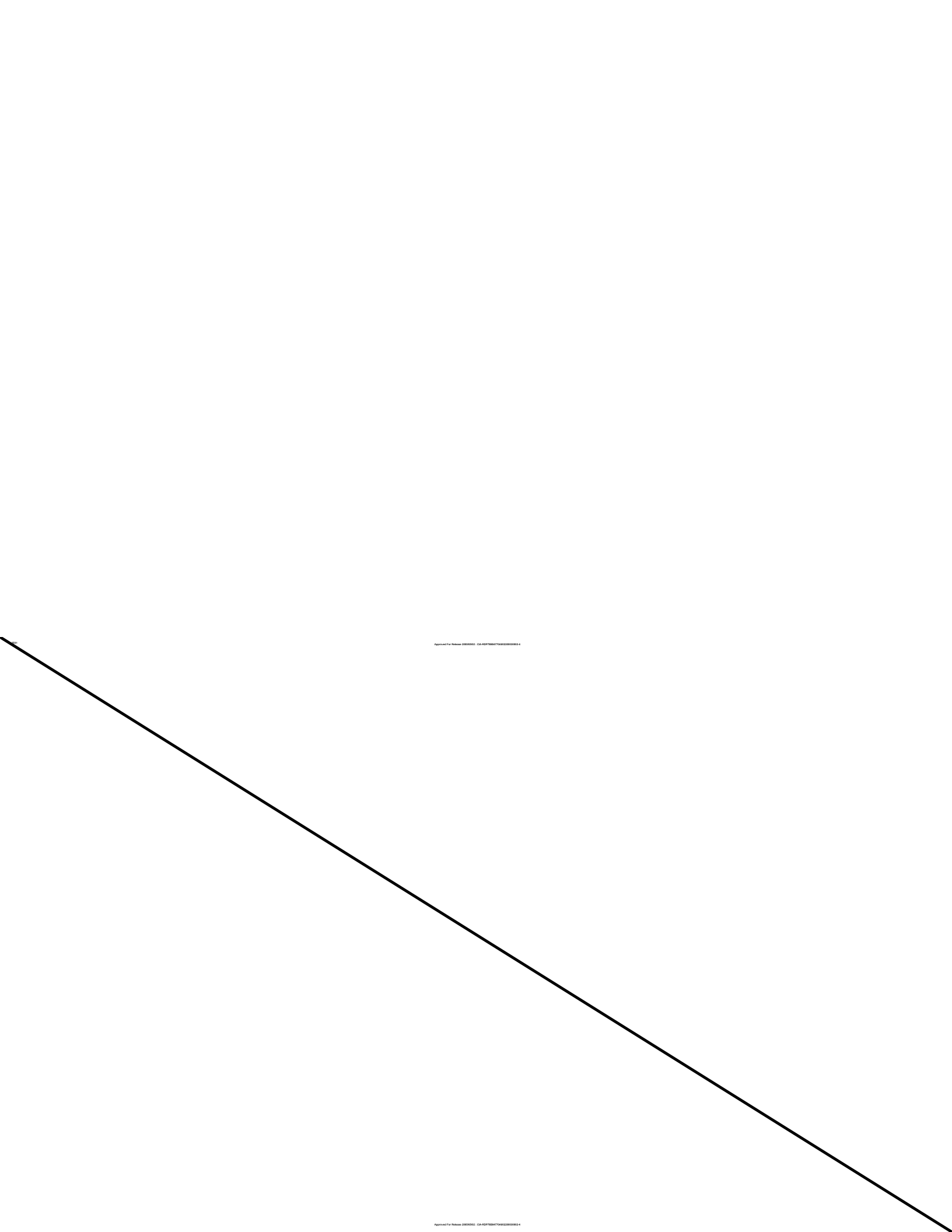
PROBLEM	PROBABLE CAUSE	REMEDY
a. No response when "Raise/Lower" switch is actuated	1. Fuse F11 2. Bridge Rectifier CR2 3. Elevating Motor	1. Check and replace if required. 2. Check D.C. voltage output. Should be 90 volts D.C. Replace if required. 3. Check continuity of field and armature. Replace if required.
b. Motor operates table does not elevate.	1. Resistor R21 and R22 2. Clutch L3	1. Check and replace if required. 2. Check continuity of clutch. Replace if required.

3.5.5 MOTOR DRIVE SYSTEM:

PROBLEM	PROBABLE CAUSE	REMEDY
a. Neither film track operating.	<p>NOTE</p> <p>Check 100 volt and 50 volt lines. Should read nominal value within 10%. Proceed if reading is not acceptable.</p> <ol style="list-style-type: none"> 1. Fuse F9 and F10 2. Transformer T11 3. Rectifier Bridge CR3 4. Capacitor C7 	<ol style="list-style-type: none"> 1. Check and replace if required. 2. Check T11 output voltage. Should be 72 volts A.C. Replace if defective. 3. Check output of CR3. Should read 50 and 100 volts D.C. per schematic R-18270. Replace if defective. 4. Check C7 capacitance. Should be 200MFD minimum. Replace if defective.
b. Individual film track inoperative.	<p>NOTE</p> <p>Place effected film track switch S15 or S16 in "OFF" position. Check resistor R10 for visual burn. Check regulated 20VDC per schematic. Should be within 10% of nominal value. If not proceed.</p> <ol style="list-style-type: none"> 1. Regulator diode CR4 2. Capacitor C7 3. Transistors Q2 and Q3 	<ol style="list-style-type: none"> 1. Check and replace if required. 2. Check and replace if required. 3. Adjust resistor R25 to approx. center position and check voltage at base of Q1 and Q4. Should be approx. 0.5 volts and will vary from 0.0 to about 0.7 when R25 is rotated to its extremes. If reading does not vary with R25 control position, transistors Q2 or Q3 is defective.

3.5.5 MOTOR DRIVE SYSTEM:

PROBLEM	PROBABLE CAUSE	REMEDY
		NOTE
		Place effected film track switch S15 or S16 in on position.
	4. Transistors Q1 and Q4	4. Read collector voltage of Q1 and Q4. Should vary from 1.5 to 100 volts as control R25 is rotated to extremes. If voltage remains at 100 volts or remains at 1.5 volts or less transistor Q1 or A4 is defective. Replace as required.
		NOTE
		If transistor Q1 or Q4 is replaced it is necessary to recalibrate the circuit.
		Calibration Procedure:
		1. Adjust R25 so that wiper voltage equals exactly 1/2 the value of the regulated 20 volt line. Leave R25 at this setting during completion of calibration.
		2. Insert 100 milliamper meter into the collector lead of Q1.
		3. Adjust resistor R36 for 90MA with motor stalled.
		4. Remove meter from Q1 and insert into Q4 collector lead.
		5. Adjust resistor R37 for 90MA with motor stalled.



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